Comparing the 2015 Pease Perfluorochemical (PFC) Blood Test Results to Other Populations Tested in the United States

December 2016

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Public Health Services
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New Hampshire Department of Health & Human Services

Purpose

The purpose of this document is to provide individuals that had their blood tested for PFCs with information about levels found in other tested populations around the United States

PFC Blood Testing Overview

- Almost everybody in the United States (U.S.) has been exposed to PFCs and can find them in their blood
- A PFC blood test is not a medical test, and there is not a PFC blood level that is considered “normal” or “abnormal”
- There is also not an established blood level for PFCs at which health problems are known or expected to occur
- There is no way to know whether finding PFCs in your blood is connected to past, present, or future health problems
- One way to understand a blood level is to compare to other tested populations

Perfluorochemical (PFC) Names and Abbreviations

PFC Name	PFC Abbreviation
Perfluorooctane sulfonic acid	PFOS
Perfluorooctanoic acid	PFOA
Perfluorohexane sulfonic acid	PFHxS
Perfluorononanoic acid	PFNA
Perfluorodecanoic acid	PFDeA
Perfluoroundecanoic acid	PFUA
Perfluorooctane sulfonamide	PFOSA
2-(N-methyl-perfluorooctane sulfonamido) acetic acid	Me-PFOSA-AcOH
2-(N-ethyl-perfluorooctane sulfonamido) acetic acid	Et-PFOSA-AcOH
Perfluorobutane sulfonic acid	PFBS
Perfluorododecanoic acid	PFDoA
Perfluoroheptanoic acid	PFHpA

Terminology

- Geometric Mean: A type of average calculated to estimate the middle level of a population
- Median: The middle level in a population (also called the 50th percentile). Half of the test results are above the median and half are below
- 95th Percentile: The level that 95% of people in a population tested below
- Range: The lowest and highest levels found in a population
- Max Level: The highest level found in a population

Distribution of All 2015 PFC Blood Test Results in the New Hampshire Pease Population

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Comparing All Individuals in the 2015 Pease Testing Program to the General U.S. Adolescent and Adult Population Tested Through the National Health and Nutrition Examination Survey (NHANES)

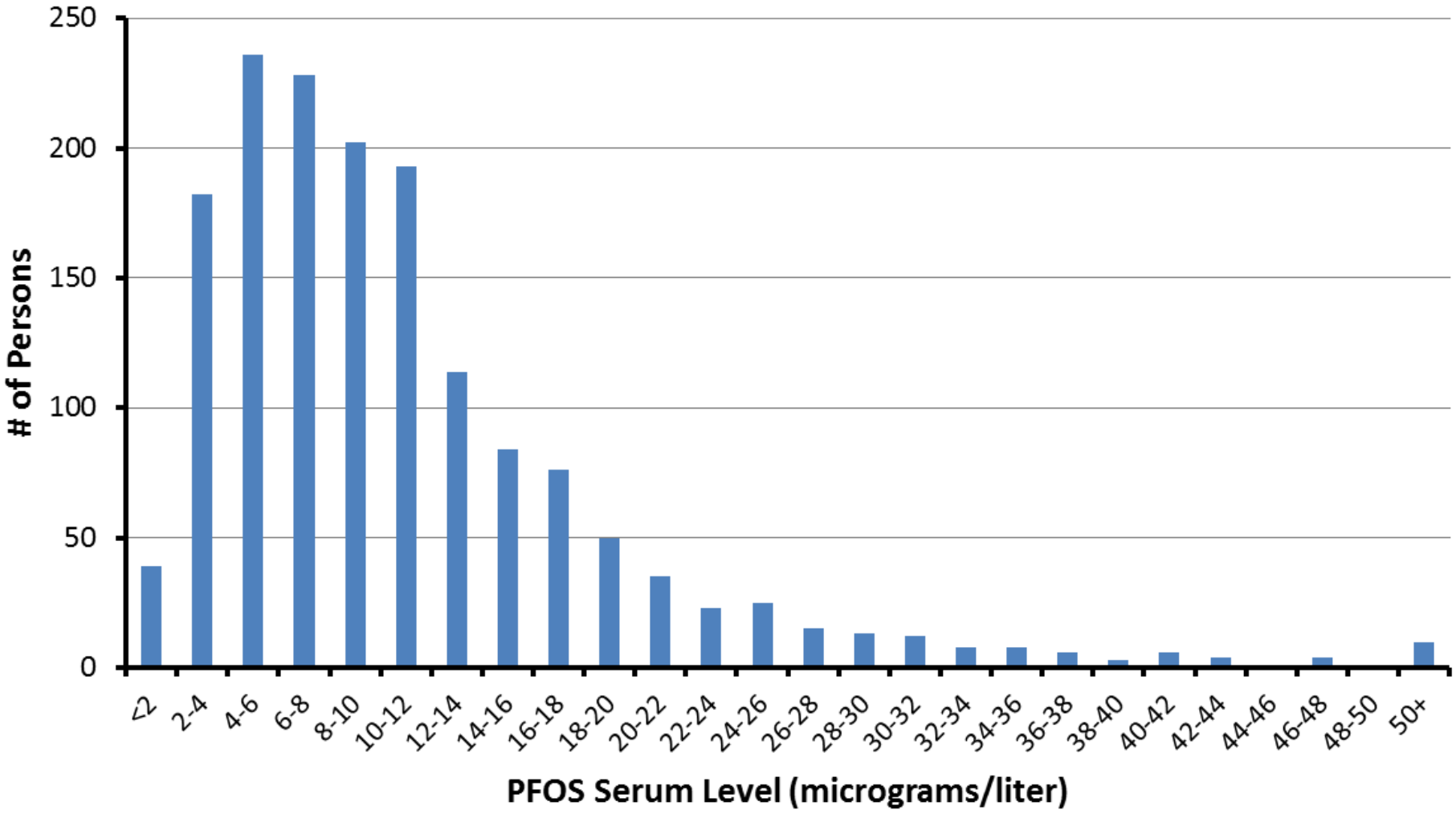
PFCs	2015 Pease Testing Population (micrograms/liter)					2011-2012 U.S. Population Data (micrograms/liter)			
	Number Tested	Median	Geometric Mean	Max Level	% of Tests Above U.S. Pop. 95th Percentile	Number Tested	Geometric Mean	Max Level	95th Percentile
PFOS	1578	8.90	8.59 *	95.6	9.1	1904	6.31	235	21.7
PFOA	1578	3.20	3.09 *	32	16.5	1904	2.08	43.0	5.68
PFHxS	1578	4.20	4.12 *	116	39.8	1904	1.28	47.8	5.44
PFNA	1578	0.74	0.73 ¥	5.2	2.2	1904	0.88	80.8	2.54
PFDeA	1578	0.35	0.22	5.6	1.6	1904	0.20	17.8	0.69
PFUA	1578	0.30	0.19	1.6	1.2	1904	NC	7.0	0.62
PFOSA	1578	0.07	0.13	0.4	N/A	1904	NC	0.6	<0.1
Me-PFOSA	878	0.07	0.09	1.6	2.1	1904	NC	4.3	0.69
Et-PFOSA	878	0.07	0.06	0.5	1.0	1904	NC	0.7	0.11
PFBS	107	0.04	0.04	0.2	N/A	1904	NC	0.8	<0.1
PFDoA	107	0.08	0.08	0.3	2.8	1904	NC	1.4	0.14
PFHpA	107	0.07	0.07	0.4	NS	1904	NC	1.0	0.22

N/A=not applicable because 95th percentile was the limit of detection, **NHANES**=National Health and Nutrition Examination Survey, **NC**=not calculated, **N**S=not shown in order to protect confidentiality, **PFC**=Perfluorochemical

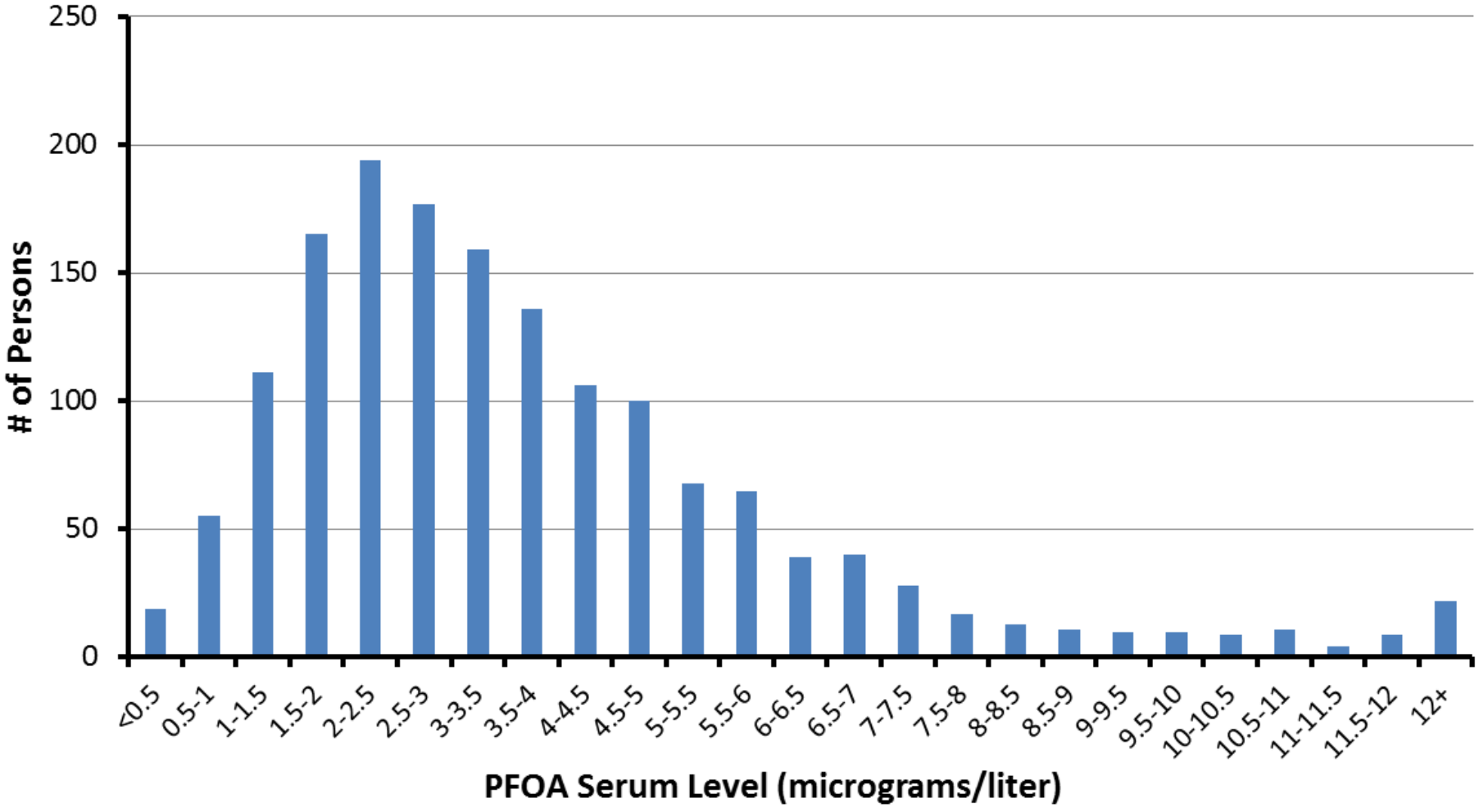
***** Indicates that the Pease geometric mean is significantly **higher** than U.S. population comparison data.

¥ Indicates that the Pease geometric mean is significantly **lower** than U.S. population comparison data.

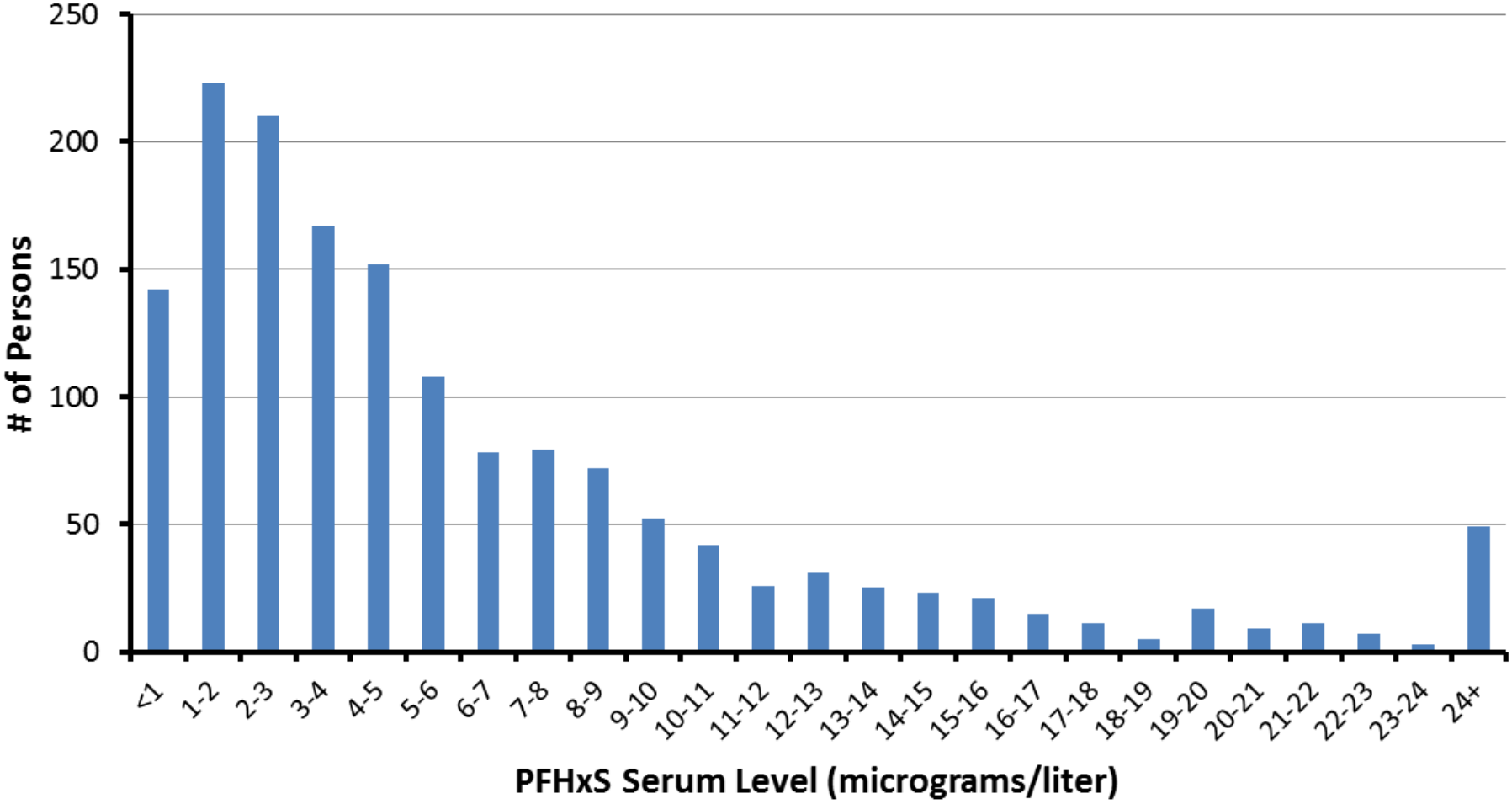
Distribution of PFOS Serum Concentrations



Distribution of PFOA Serum Concentrations



Distribution of PFHxS Serum Concentrations



Comparison of the New Hampshire 2015 Pease Blood Test Results to Other U.S. Populations

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Comparing Adolescents and Adults (12 years of age and older) in the 2015 Pease Testing Program to the General U.S. Adolescent and Adult Population Tested Through the National Health and Nutrition Examination Survey (NHANES)

PFCs	2015 Pease Adolescents & Adults (micrograms/liter)					2011-2012 U.S. Population Data (micrograms/liter)			
	Number Tested	Median	Geometric Mean	Max Level	% of Tests Above U.S. Pop. 95th Percentile	Number Tested	Geometric Mean	Max Level	95th Percentile
PFOS	1212	9.17	8.74 *	95.6	10.2	1904	6.31	235	21.7
PFOA	1212	3.10	2.99 *	32.0	15.7	1904	2.08	43.0	5.68
PFHxS	1212	4.16	4.21 *	116.0	39.4	1904	1.28	47.8	5.44
PFNA	1212	0.70	0.68 ¥	4.9	1.1	1904	0.88	80.8	2.54
PFDeA	1212	0.30	0.22	5.6	1.9	1904	0.20	17.8	0.69
PFUA	1212	0.30	0.19	1.6	1.6	1904	NC	7.0	0.62
PFOSA	1212	0.07	0.12	0.4	N/A	1904	NC	0.6	<0.1
Me-PFOSA	713	0.07	0.09	1.6	1.3	1904	NC	4.3	0.69
Et-PFOSA	713	0.07	0.06	0.4	1.0	1904	NC	0.7	0.11
PFBS	106	NC	NC	NS	N/A	1904	NC	0.8	<0.1
PFDoA	106	NC	NC	NS	NS	1904	NC	1.4	0.14
PFHpA	106	NC	NC	NS	NS	1904	NC	1.0	0.22

N/A=not applicable because 95th percentile was the limit of detection, **NHANES**=National Health and Nutrition Examination Survey, **NT**=not tested, **NC**=not calculated, **N**S=not shown in order to protect confidentiality, **PFC**=Perfluorochemical

***** Indicates that the Pease geometric mean is significantly **higher** than U.S. population comparison data.

¥ Indicates that the Pease geometric mean is significantly **lower** than U.S. population comparison data.

Comparing Children (<12 years of age) in the 2015 Pease Testing Program to the General U.S. Adolescent and Adult Population Tested Through the National Health and Nutrition Examination Survey (NHANES)

PFCs	2015 Pease Children (micrograms/liter)					2011-2012 U.S. Population Data (micrograms/liter)			
	Number Tested	Median	Geometric Mean	Max Level	% of Tests Above U.S. Pop. 95th Percentile	Number Tested	Geometric Mean	Max Level	95th Percentile
PFOS	366	8.27	8.11 *	30.8	5.2	1904	6.31	235	21.7
PFOA	366	3.63	3.43 *	12.0	19.4	1904	2.08	43.0	5.68
PFHxS	366	4.24	3.83 *	31.7	41.3	1904	1.28	47.8	5.44
PFNA	366	0.90	0.92	5.2	6.0	1904	0.88	80.8	2.54
PFDeA	366	0.35	0.23	0.7	0.6	1904	0.20	17.8	0.69
PFUA	366	0.35	0.18	0.5	0	1904	NC	7.0	0.62
PFOSA	366	0.35	0.17	0.4	N/A	1904	NC	0.6	<0.1
Me-PFOSA	165	0.07	0.10	1.3	5.5	1904	NC	4.3	0.69
Et-PFOSA	165	0.07	0.07	0.5	1.2	1904	NC	0.7	0.11
PFBS	1	NC	NC	NS	N/A	1904	NC	0.8	<0.1
PFDoA	1	NC	NC	NS	NS	1904	NC	1.4	0.14
PFHpA	1	NC	NC	NS	NS	1904	NC	1.0	0.22

N/A=not applicable because 95th percentile was the limit of detection, **NHANES**=National Health and Nutrition Examination Survey, **NC**=not calculated, **N**S=not shown in order to protect confidentiality, **PFC**=Perfluorochemical

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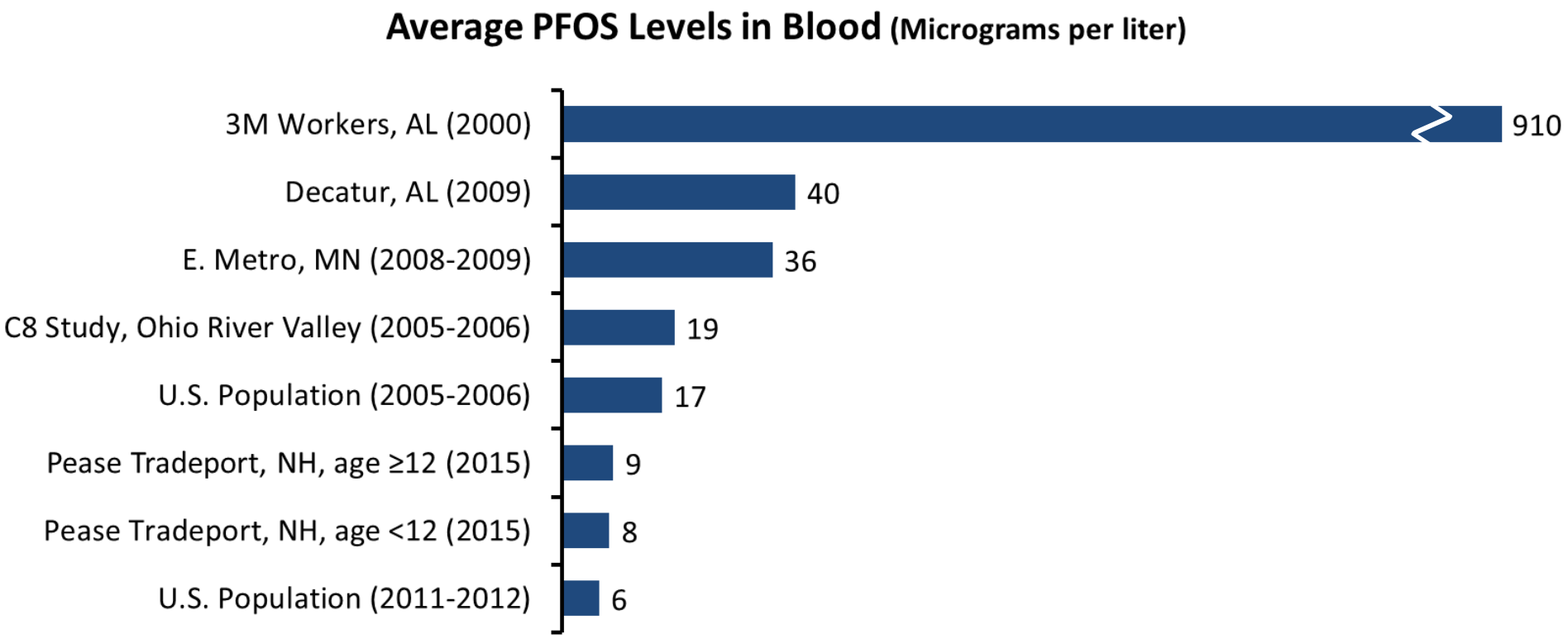
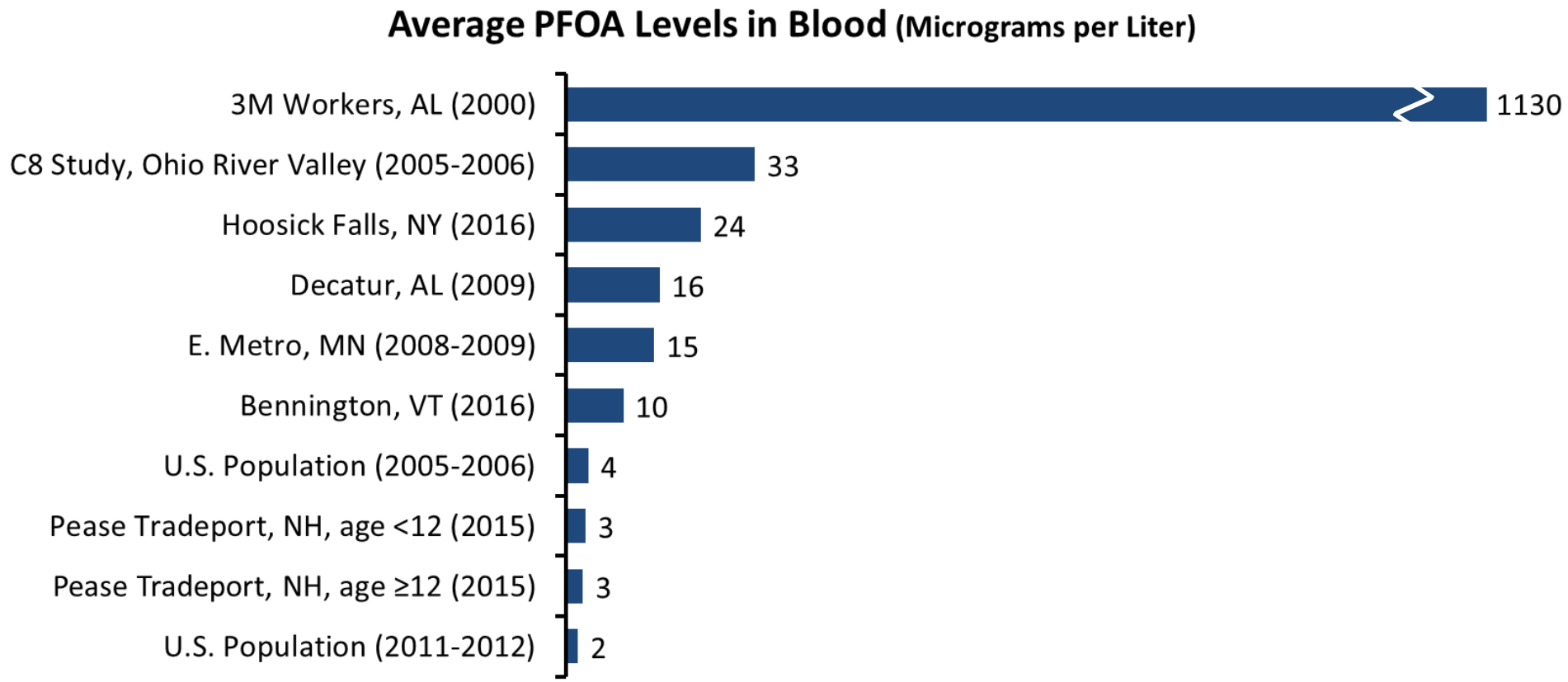
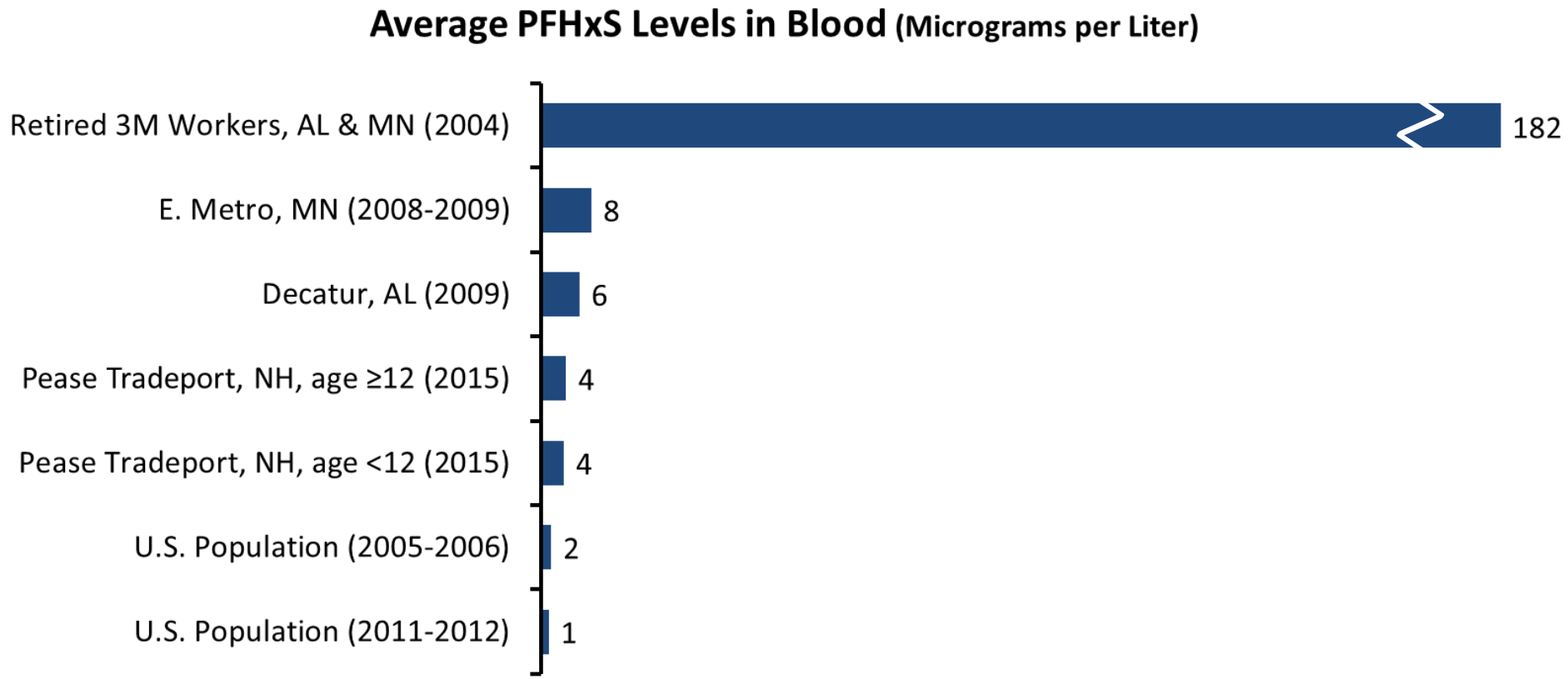
Comparison of Average Blood PFOS Levels in Various U.S. Populations to NH Pease Adolescents/Adults (Age ≥ 12) and Children (Age < 12)



Comparison of Average Blood PFOA Levels in Various U.S. Populations to NH Pease Adolescents/Adults (Age ≥ 12) and Children (Age < 12)



Comparison of Average Blood PFHxS Levels in Various U.S. Populations to NH Pease Adolescents/Adults (Age ≥ 12) and Children (Age < 12)



References for Comparison Populations

Study Population	Years Blood Tested	# of Participants	Reference
3M workers, AL	2000	263	Olsen GW, et al. Epidemiologic assessment of worker serum perfluorooctanesulfonate (PFOS) and perfluorooctanoate (PFOA) concentrations and medical surveillance examinations. J Occup Environ Med. 2003;45(3):260-270.
Retired 3M workers, AL & MN*	2004	26	Olsen GW, et al. Half-life of serum elimination of perfluorooctanesulfonate,perfluorohexanesulfonate, and perfluorooctanoate in retired fluorochemical production workers. Environ Health Perspect. 2007;115(9):1298-1305.
C8 Study, Ohio River Valley	2005-2006	69,030	Frisbee et al. The C8 Health Project: Design, methods, and participants. Env Health Persp 2009;117(12):1873-82.
Decatur, AL	2009	153	ATSDR. Exposure Investigation Report: PFC serum sampling in the vicinity of Decatur, AL Morgan, Lawrence, and Limestone Counties. Apr 2013. Accessed
E. Metro, MN	2008-2009	196	Minnesota Dept of Health. East Metro PFC biomonitoring pilot project. Jul 2009. Accessed at: http://www.health.state.mn.us/divs/hpcd/tracking/biomonitoring/projects/pfcfinalrpt2009.pdf
Hoosick Falls, NY	2016	2,081	New York State Department of Health. PFOA in Drinking Water in the Village of Hoosick Falls and Town of Hoosick, Preliminary Participant Results. August 2016; Website: https://www.health.ny.gov/environmental/investigations/hoosick/.
Bennington, VT	2016	477	Vermont Department of Health. PFOA Blood Test Results for Bennington/North Bennington. August 2016. Website: http://healthvermont.gov/enviro/pfoa_clinics.aspx#info.
U.S. Population (NHANES)	2005-2006 2011-2012	2120 1904	CDC. Fourth National report on human exposure to environmental chemicals. Feb 2015. Accessed at: http://www.cdc.gov/exposurereport/

***** Note: All populations reported geometric mean for an “average” except for the “Retired 3M Workers” which reported arithmetic mean.

Summary

- Levels of PFOS, PFOA, and PFHxS in Pease children, adolescents, and adults are slightly, but statistically higher, compared to levels in the general U.S. adolescent and adult population tested in 2011-2012 (tested through NHANES)
- The difference in PFOS, PFOA, and PFHxS levels ranges from about 1 – 3 micrograms per liter higher in the Pease population compared to the most recently tested general U.S. population
- Levels of PFOS and PFOA in Pease participants are similar or lower compared to levels seen in the general U.S. population 10 years ago (i.e., tested in 2005-2006 through NHANES)
- Levels of PFHxS in Pease participants are higher compared to the U.S. population, but they are still lower than some levels seen in other environmentally or occupationally exposed individuals

Comparison of the New Hampshire 2015 Pease Children (< 12 years of age) Blood Test Results to Other U.S. Pediatric Populations

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Overview

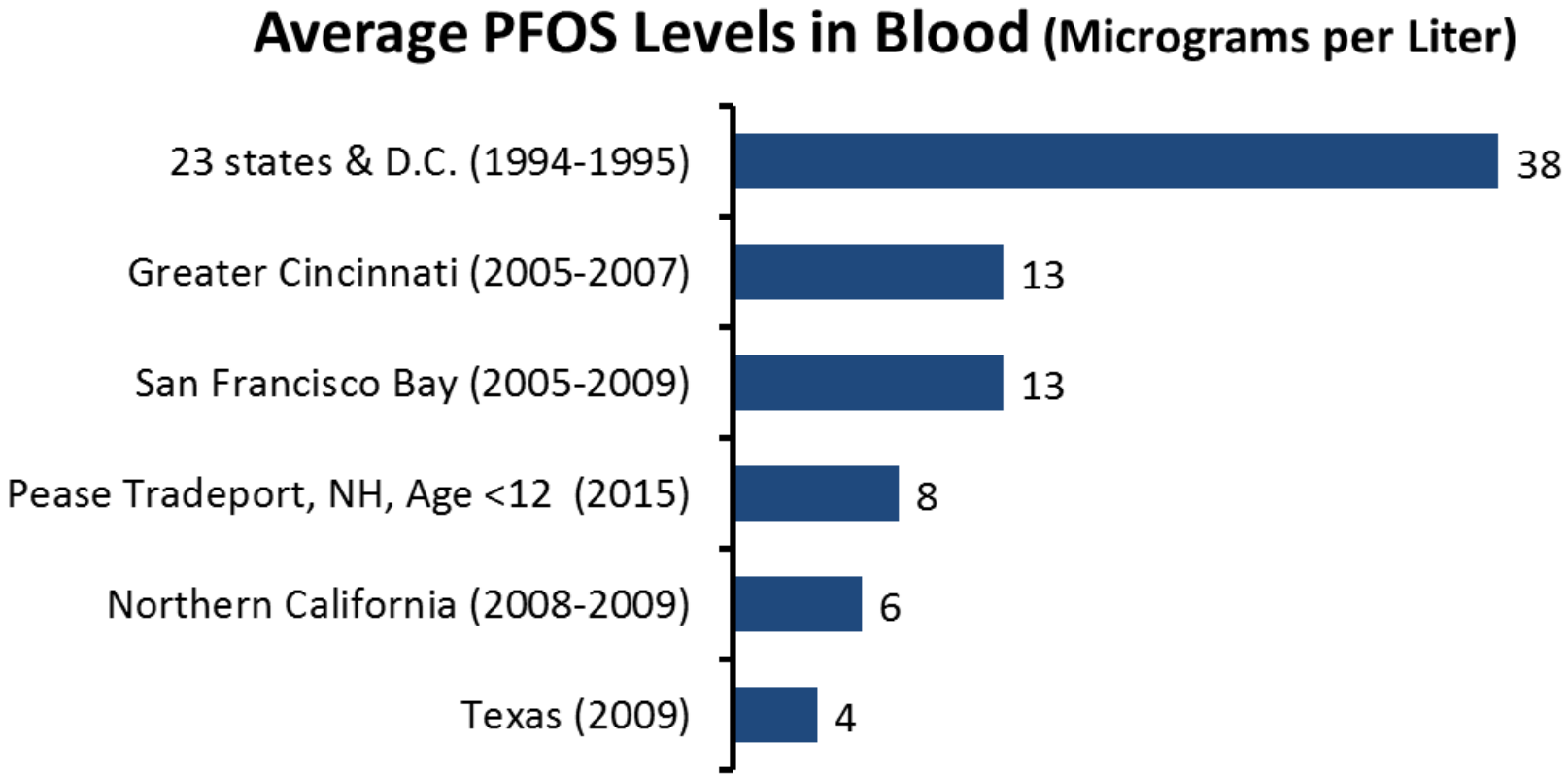
- Individuals have asked for information about a study of Texas children tested for PFCs, so we have provided a table comparing the Pease children to Texas children
- Given the limited information published from the Texas study, we are unable to assess for statistically significant differences in PFC levels between Pease children and Texas children
- The study of Texas children is a small single study and is not representative of PFC exposure in the general U.S. child population. Therefore, we have provided comparisons to other studies of U.S. children that do not have any known specific PFC exposures to serve as additional comparisons

Comparing Children (<12 years of age) in the 2015 Pease Testing Program to a Study of 300 Texas Children

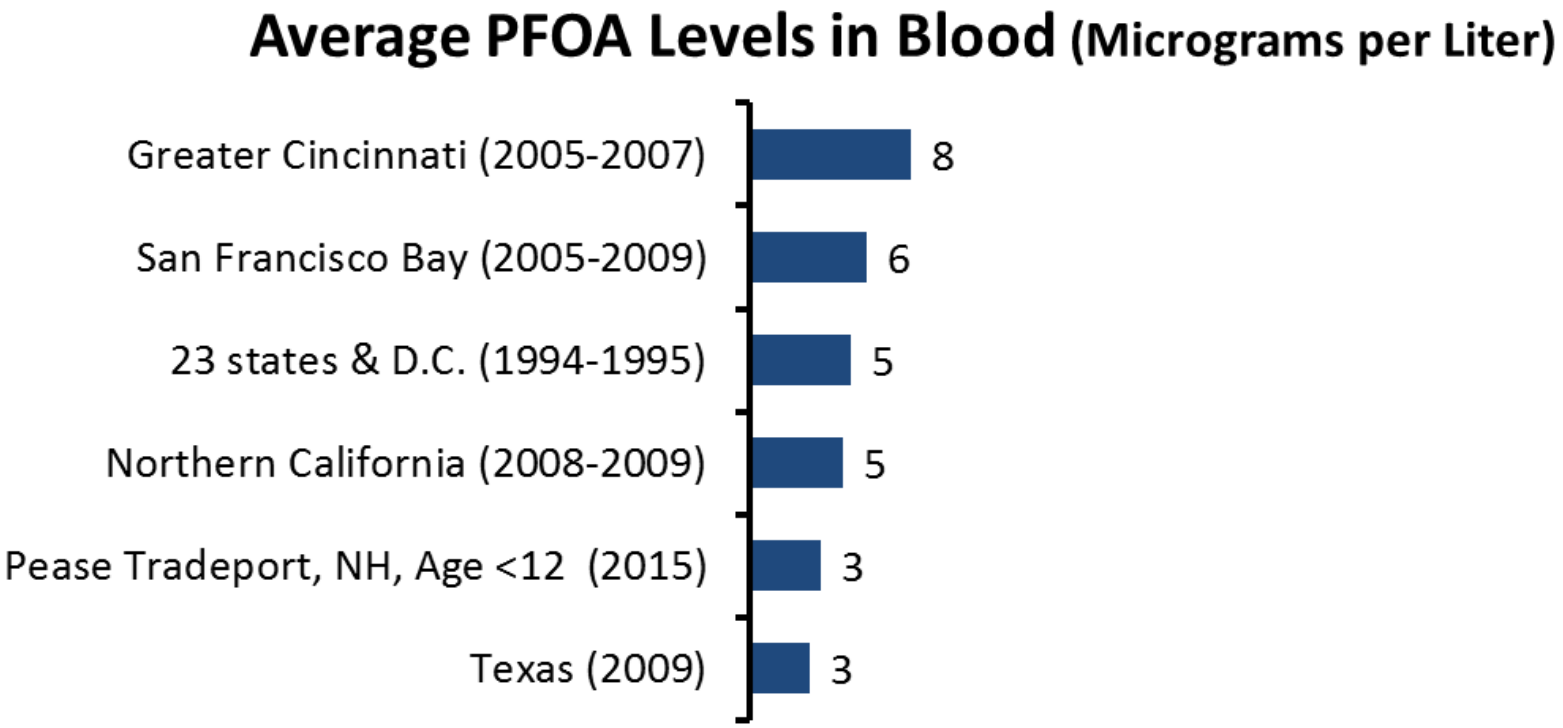
PFCs	2015 Pease Children (micrograms/liter)				Texas Children (micrograms/liter)		
	Number Tested	Median	Geometric Mean	Max Level	Number Tested	Median	Max Level
PFOS	366	8.27	8.11	30.8	300	4.1	93.3
PFOA	366	3.63	3.43	12.0	300	2.9	13.5
PFHxS	366	4.24	3.83	31.7	300	1.2	31.2
PFNA	366	0.90	0.92	5.2	300	1.2	55.8
PFDeA	366	0.35	0.23	0.7	300	<0.2	2.1
PFUA	366	0.35	0.18	0.5	NT	NT	NT
PFOSA	366	0.35	0.17	0.4	300	<0.1	0.6
Me-PFOSA	165	0.07	0.10	1.3	300	<0.2	28.9
Et-PFOSA	165	0.07	0.07	0.5	300	<0.2	0.7
PFBS	1	NC	NC	NS	NT	NT	NT
PFDoA	1	NC	NC	NS	NT	NT	NT
PFHpA	1	NC	NC	NS	NT	NT	NT

NT=not tested, **NC**=not calculated, **N**S=not shown in order to protect confidentiality, **PFC**=Perfluorochemical

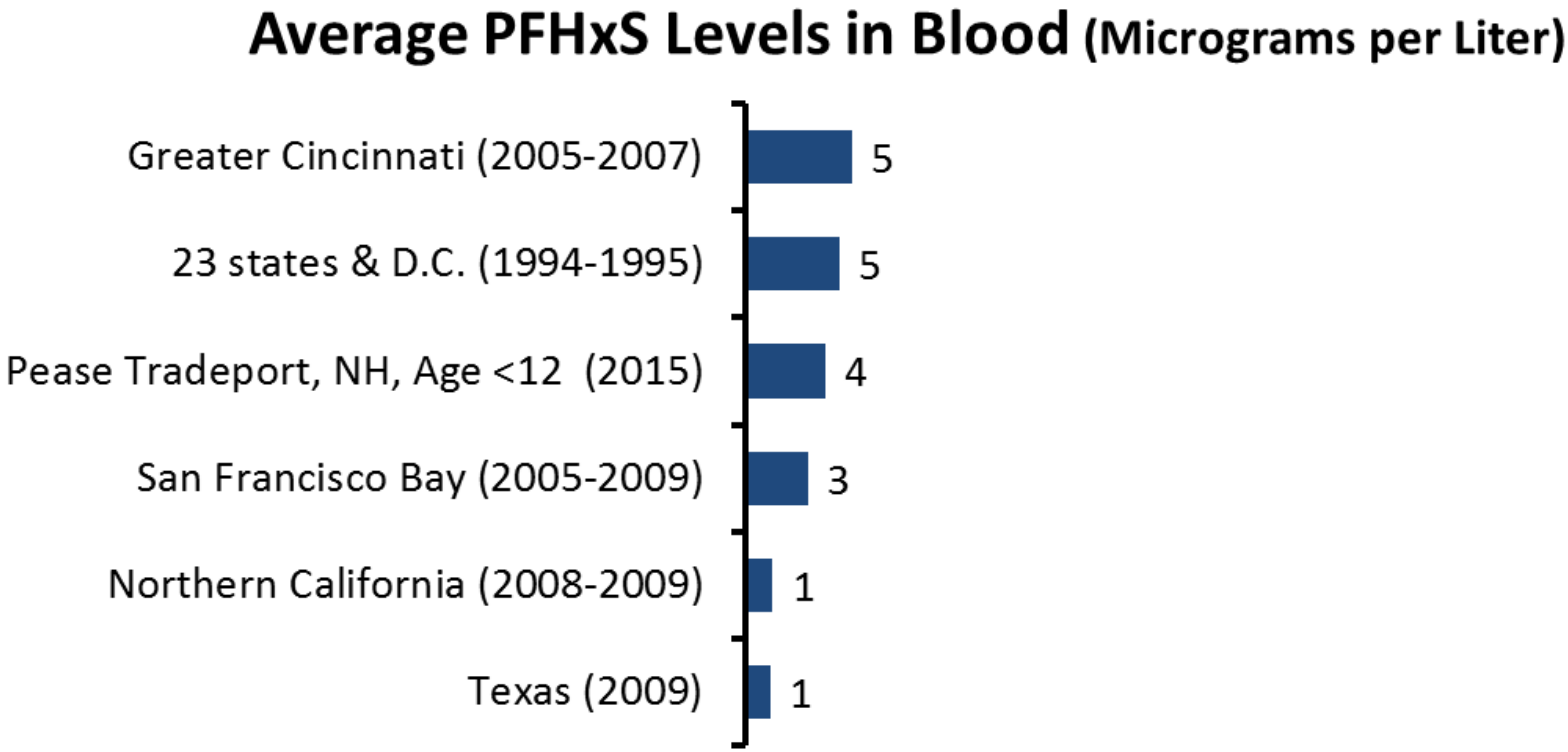
Comparison of Average Blood PFOS Levels in Various U.S. Pediatric Populations to NH Pease Children (Age < 12)



Comparison of Average Blood PFOA Levels in Various U.S. Pediatric Populations to NH Pease Children (Age < 12)



Comparison of Average Blood PFHxS Levels in Various U.S. Pediatric Populations to NH Pease Children (Age < 12)



References for Comparison Populations

Location	Years of Testing	# of Participants	Age Range	Reference
23 States + D.C.	1994-1995	598	2-12	Olsen et al. Quantitative Evaluation of Perfluorooctanesulfonate (PFOS) and Other Fluorochemicals in the Serum of Children. J Child Health 2004;2(1):53-76.
Greater Cincinati	2005-2007	353	6-8	Pinney SM, et al. Serum Biomarkers of Polyfluoroalkyl Compound Exposure in Young Girls in Greater Cincinnati and the San Francisco Bay Area, USA. Environ Pollut 2014;184:327-
San Francisco Bay	2005-2009	351	6-8	Pinney SM, et al. Serum Biomarkers of Polyfluoroalkyl Compound Exposure in Young Girls in Greater Cincinnati and the San Francisco Bay Area, USA. Environ Pollut 2014;184:327-
Northern California	2008-2009	68	2-8	Wu et al. Serum concentrations of perfluorinated compounds (PFC) among selected populations of children and Adults in California. Environ Res 2015; 136:264-73.
Texas*	2009	300	0-12	Schecter et al. Polyfluoroalkyl Compounds in Texas Children from Birth through 12 Years of Age. Environ Health Perspect 2012;120:590-594.

***** Note: All populations reported geometric mean for an “average” except for the “Texas” study which reported median.

Summary

- Blood levels of PFOS, PFOA, and PFHxS in NH Pease children are similar to levels seen in other child studies conducted over the last approximately 10 years
- There is no nationally representative study of children to give a better idea of what PFC levels a child in the U.S. is typically exposed to
- There may be multiple differences between Pease children and children in these various studies which we cannot know about that account for differences in PFC blood levels

More Information

For more detailed information about findings from the 2015 Pease PFC Blood Testing Program, or for more information about PFCs in general, please visit the website:
http://www.dhhs.nh.gov/dphs/pfcs/index.htm

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